

**David Mercer, Associate Professor, STS, School of History and Social Inquiry,
University of Wollongong Australia**

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Title: Constructively negotiating the tensions between communicating and thinking about science 'in particular' and science 'in general'.

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The tensions between communicating about 'science in general' (often involving direct considerations of the philosophy and sociology of science) and 'science in particular' (more immediate implications of specific knowledge and practices) re-appears regularly in contexts involving controversial science and technology. In these contexts, when regulators and publics are called on to evaluate the specific implications of new controversial areas of science they regularly become drawn into also considering various broader universalistic epistemic dimensions of science: Particularly in longer standing controversies. This can involve considerations of the scientific method, science as world view, science as progress, science vs. values; science vs junk science. (These sometimes involve drawing on what I like to describe as 'folk epistemologies' which in some cases refer in passing to famous philosophers of science such as T.S. Kuhn or Karl Popper, more on this below).

Making the distinction between 'science in general' and 'science in particular', is not completely straightforward, as communicating and deliberating about the specific implications of science and technology will always involve framing by some kind of implicit philosophies and or sociology of science. Because of this, one of the points I will return to in my conclusion, is not that science communicators avoid considerations of 'science in general' altogether, which is not really possible, but that they make efforts to promote in public debate (about controversial science and technology) more contextually adequate images of science and technology that hopefully don't lend themselves so easily to the problems I will document below.

From the outset I'd like to note that when debate involving these broader images of science become a feature of science communication (involving controversial science) *they can* invite constructive broader dialogue about the politics and philosophy of science and science and ethics, which has some obvious value. There can nevertheless also be, and I think it is more often the case, some significant pitfalls. The most important of these is when dialogue relating to specific implications of a controversial area of science and technology becomes unnecessarily confused by being linked to such broader visions, which are, often by their nature, difficult to pronounce on in a definitive way, difficult to apply to practice, or difficult to meaningfully discuss in communicative contexts which are unsuited to such deliberations. In these contexts opportunities are opened for more specific immediate scientific claims and their implications to be prone to spirals of deconstruction and

reconstruction set against a backdrop of impoverished public discourses involving ‘sound-bite’ philosophy and sociology of science.

Most often this takes the form of some kind of quite unrealistic folk epistemology of what counts as good science being used as an unrealistic measure which is used to throw doubt on specific scientific claims. Even widely accepted generally sound scientific claims when they are novel and contain some uncertainties can face difficulties in measuring up against various ideal models of what it is assumed good science should look like. I am not suggesting here that various references to ideas drawn from specialist academic fields like the philosophy and sociology of science should be completely avoided in public debate, but rather, that science communicators need to be much more aware and critical when these ideas are introduced into broader public settings than is often the case. I will return to this theme at the end of my paper after I have illustrated my claims with some examples.

The possibility for scientific knowledge to be vulnerable to deconstruction in certain public and regulatory venues has been commented on in a number of contexts. It has for instance been noted to regularly occur in some legal and regulatory settings, particularly ones where long standing areas of controversy are being aired, and where well-resourced parties can refine awkward lines of interrogation over time. One of the ‘binds’ that experts in such settings face is that if they fail to project an unrealistically certain image of science they risk limiting the public/legal authority of their claims but if they project unrealistic images of scientific certainty their claims then become increasingly vulnerable to being ‘deconstructed’: And in settings where scientists have limited control of the types of questions that are being asked. To put it another way, unrealistic images of science in general coupled with the struggle to maintain authority in critical public environments can lead scientists/experts to the risk of being ‘Hoist on their own positivist petard’s”

Science Studies scholars such as Sheila Jasanoff and Brian Wynne have noted that these risks of deconstruction of expert claims in public legal and regulatory settings can have positive democratic political implications by providing, in a sense, public lessons in the social studies of science. That is the messiness of deconstruction helps expose to wider audiences outside of scientific ones the importance of theoretical pre-suppositions, social interests, uncertainties, craftwork, trust and social practices intrinsic to science. For Jasanoff, in the broad historical context of publicly visible civil litigation in the United States, these forms of deconstruction have provided a subtle but important form of ‘civic education’ which has acted as a countermeasure to the technocratic tendencies predominant in the normal patterns of the governance of science and technology.

Following from Jasanoff’s observations about civic education, science communicators could justifiably extrapolate and draw the conclusion that references to folk epistemologies and ‘science in general’, whilst confusing and often contradictory in themselves, might act as catalysts for the generation of more realistic public expectations about how science actually works in practice and not necessarily be discouraged.

There have nevertheless, been some less sanguine views about the possibilities of deconstruction of science in public settings offering much by way of civic education.

One strand of criticism has noted that deconstructions of scientific claims are frequently accompanied by unusual processes of reconstruction. These processes can at times be ad-hoc, less accountable than, and more overtly politicised than the processes involved in the original construction and certification of scientific claims. Rather than take-away with them more realistic images of the practices and philosophies of science, public audiences to the deconstruction of science may more often simply be left, ambivalent and confused with a choice of uncritically adopting whatever scientific positions have been reconstructed in place of what has originally been ‘taken down’. These processes can also have a political edge as audiences may decide to choose whatever reconstruction of science resonates with their interests aside from its coherence or reliability. It is also often those with the best resourced arguments, not the better arguments, who are at an advantage in reconstructing positions that survive public debate. This type of problem has been implicit in many critiques of public understanding of the science of global warming.

Some literature has suggested that increasingly, particularly in the US, a recognisable form of unreasonable scepticism involving the deconstruction of certain areas of science appears to be much more common amongst supporters of the political right. Writers such as Chris Mooney have documented what they believe has been “The Republican War against Science”. These contentions have been supported by empirical studies of US public attitudes to science and been exposed as an important ingredient of the strategies of Big Tobacco to limit regulation of Tobacco and the related efforts of politically conservative think tanks to thwart regulation to address climate change.

Whilst there is evidence that there do seem to be patterns to the ways political conservatives currently engage with controversial science and technology. I think that there is also evidence that the tendencies described above are not a unique feature of conservative political engagement with science.

In many long standing /ongoing scientific controversies over the last couple of decades, strategies for deconstruction of scientific claims by juxtaposition with unrealistic images of ‘science in general’ appear quite common: these tendencies re-appear in controversies involving topics as diverse as: anti-vaccination, GM, alternative medicine, anti-nuclear movements, creation science, all which feature more complex political alignments than those identified by Mooney and similar minded commentators.

In terms of mainstream trends in regulatory science I think it is also a reasonable observation that this pattern of strategic mistrust of expertise has also contributed to something of a technocratic backlash. As Theodore Porter has noted it is under these types of conditions of mistrust in expertise that there will be a growth in appeals to ‘mechanical objectivity’ featuring: auditing, ‘trust in numbers’ and calls for ‘precision’ (even at the cost of accuracy) and ‘evidence’ based policy. What we are more often than not left with then, in public arenas in areas involving controversial science and technology, is a mixture of scientific deconstructions/ reconstructions (frequently dominated by the wealthiest, loudest or best organised interest groups) in competition with technocracies attempting to put as much ‘square’ scientific knowledge into ‘round’ evidence based holes as possible to force closure of debate.

All of this set against rather confused and confusing references back to unrealistic folk epistemologies of ‘science in general’.

Probably the most visible area of science where these trends manifest themselves has been in climate change debates. Whilst debates about climate change have taken different forms in different countries in terms of policy, the persistence of minority scientific claims, and the significant place they have and continue to occupy in public and regulatory discourse across the world, provides a good arena for investigating the tensions between communicating science in general and particular and the challenges of the politics of deconstructing/ reconstructing science.

One of the key features of the longevity of climate sceptic positions has been the use sophisticated PR campaigns based on finely tuned strategies of various political lobby groups with ideological opposition to regulation of health and environmental risks. Most notably, long standing efforts to resist tobacco regulation has provided a fertile ground for these strategies to evolve. Although I think it would be worth re-iterating the point that various activist groups when challenging mainstream scientific position haven’t also been averse to adopting (albeit less well-resourced) similar strategies.

Let me provide below a few brief examples of the ways juxtapositioning of folk epistemologies of science in general with the necessary ‘imperfections’ of science in particular have been used in different ways in climate change debates. In one instance to attempt to deconstruct mainstream climate change science and in another the claims of climate sceptics.

“The Scientific Alliance: Challenging and informed scientific debate” is a UK based web site and is a typical of a multitude of similar web sites produced by various anti global warming lobbies. I chose it partially because it displays at a superficial level, at least, a moderate and learned tone. Its web site is very professionally laid out.

They provide numerous links to their anti- global warming commentaries, some of them having been published as letters or opinion pieces in mainstream media such as the *Guardian*. They provide a link to their scientific advisory board. Typical of these groups, advisors in fields adjacent to, but not integral to investigating the science of climate change, dominate. The board features retired industrial chemists, ex-industry consultants, professors of chemistry, some statisticians and a human geographer.

In their commentary “Time for a New Paradigm on Climate Change” they discuss the philosophies of science of Popper and Kuhn and rue the fact that most scientists concerned with global warming seem to be far too Kuhnian and are therefore uncritical, they suggest if scientists were more Popperian, many global warming claims would be falsified and have to be rejected.

Let me provide just 3 short extracts to present a feel for the way their case is developed. The first helps explain their view of what Popper’s philosophy of science involves, the second and third, the implications they believe that would flow if a Popperian approach was adopted.

“Popper argued that all science is based on hypotheses, which must be tested to destruction. Sound evidence which does not fit with the hypothesis must logically cause it to be rejected. However, the

other side of the same coin is that no hypothesis can ever be said to be proven. Over time, the body of evidence consistent with a successful hypothesis builds up to the extent that it becomes regarded as a theory, for example the theory of General Relativity, or Tectonic Plate theory”.

“There are a number of observations which would apparently serve to falsify the hypothesised enhanced greenhouse effect”

The behaviour of a great many researchers involved in climate change is far from Popperian. Rather than test their hypothesis by trying to falsify it, they look instead for evidence which supports it and, in a deeply unscientific manner, will often simply dismiss contrary evidence on the basis of minor flaws or criticism. This is research done according to prejudice rather than with an open mind. To compound the error, and because evidence can only be gathered by observation rather than experiment, increasing reliance has been placed on computer models.

It is quite easy to find in similar genre’s of communication diametrically opposed uses of Popper. I have chosen as an example a commentary (blog) titled *Can Popper Resolve the Global Warming Debate?* written by Richard Lawson a retired GP and psychiatrist, author, past speaker for the Green party and past Green District Councillor published by the trendy on line News service the Huffington Post (Huff Politics UK version (for whom he blogg’s for).

A little like the Scientific Alliance, early on, he sets out what he takes to be the main feature of Popper’s philosophy of science:

There is a common misconception that science "proves" things. It does not. The great philosopher of science, Karl Popper, showed that the best status that any scientific statement can achieve is not "proven", but "not yet disproven". Refutation is central to science. If a statement is not capable of refutation, it cannot be a scientific statement.

He then moves on to argue that the central claim of the climate sceptics is the hypothesis that climate sensitivity is low (“that is, the global temperature does not rise significantly when more heat is put into the system”), that various pieces of evidence refute this hypothesis, but this refutation is too rarely promoted by scientists in the public domain, to quote:

There are a small number of papers by sceptics which claim a low value [of global warming] around 0.5°C. These have been comprehensively criticised on various grounds by the climate science community - indeed, they would say "refuted" - but because of the technical nature of the argument, and the media-shy nature of scientists generally, this part of the debate rarely emerges into the public domain.

So, it follows that we can answer the rhetorical question in the title of Lawson’s commentary in the affirmative, and yes, more public awareness of Popper could indeed help resolve the global warming debate...unless of course ‘the public’ had just been reading and taking seriously web sites like the *Scientific Alliance* where they

would have learned that if scientists followed Popper they would reject global warming.

Whilst both commentators no doubt believe that their reference points to Popper give their claims more authority I'd suggest rather, that in both cases they offer an unnecessary distraction and simply build confusion. Part of the reason that a pop version of Popper (folk epistemology) is useful to both parties is that it is so general and universal (testing and refutation) that it can be applied in almost any setting to corrode almost any novel claim as long as the critic plays 'awkward student' with sufficient guile.

More messy straightforward images of how science is actually done can be made appear to lack authority relative to the clean application of images of Popperian criterion. In the first example computer modelling is deemed implicitly untestable and therefore unscientific, in the second, the claims of scientific sceptics can be simply enumerated and refuted.

Both uses (mis-uses?) of Popper are clearly unhelpful in encouraging informed public debate. In the first example, the fact that computer modelling, whilst sometimes not as testable as textbook images of science, is still immensely powerful and used uncontroversially in innumerable practical settings in the modern world is obscured. In the second example a number of observations (quite reasonable in themselves) about the weaknesses of climate sceptic arguments for low climate sensitivity, are linked to a simple Popperian refutation. The style of argument in the second example invites a fairly obvious 'double edged' Popperian style retort from the climate sceptic lobby demanding mainstream claims for global warming to also be enumerated with sufficient precision to be simply tested. These types of demands for simple precise enumeration and testing provide a fertile ground for sceptics to deconstruct in public arena's scientific claims involving enumeration. Scientific claims couched in terms of revisable statistical that would be acceptable in the relevant specialist communities are made appear lacking.

I should emphasise that whilst folk epistemologies inspired by Popper (and probably many other philosophies of science) may be particularly well suited to the task of deconstruction of scientific claims, particularly in contexts involving public debate surrounding controversial science and technology, that the points I am trying to make are much more generally applicable. From a slightly more sociological vantage, for instance, the use of unrealistically (implicitly Mertonian inspired) ideal views of peer-review have also played similar roles to Popper in climate change debates. For example many defenders of the climate science consensus note in public contexts the importance of peer-review as a measure of the quality of the science. Such claims are often framed in ideal terms without considering what peer-review actually means in the specific contexts relevant to their concerns. For example the IPCC no doubt uses peer review processes not dissimilar to other 'like-minded' international advisory groups, but these processes don't always accord neatly with Mertonian classic sociology of science images of double blind peer review. Without care about how 'science in general' and 'science in particular' are communicated even an area where one would imagine the consensus views of climate scientists are at their strongest can become a point of vulnerability in public debate.

If we can accept the general points made above: (i) that the use of images of ‘science in general’ can play an important role in deconstructing scientific claims, particularly in controversial settings, (ii) that these forms of deconstruction don’t necessarily afford the public (broadly understood) particularly useful lessons in sociology or philosophy of science, and (iii), that they can be highly politically motivated and the reconstructions of science we are left with inadequate, the question remains how should these tendencies be avoided and what are the alternatives?

Unfortunately don’t believe there is any simple answer (particularly if we acknowledge that avoiding these types of discussions altogether is unrealistic and probably undesirable): But I think the following points, outlined below, constitute a good starting point for science communicators to become better equipped to deal with the pitfalls identified in my discussion above:

(a) Start from the assumption that science and technology takes diverse forms, so it shouldn’t be surprising that applying one size fits all folk epistemologies to determine whether something is scientific or not may be unhelpful and prone to re-appropriation.

(b) Be sensitive to what various academic fields actually do. For example it shouldn’t be surprising if differences are identified between what counts as a test and or a proof for a geologist as opposed to an atmospheric physicist.

(c) Display more awareness of the interdisciplinary, goal directed orientation of many areas of science and technology today and put more effort into describing some of the challenges involved in bringing different fields together for innovation and regulation.

(d) ‘Critique in context’: Whilst in many contexts science communicators should be critical of the claims made by scientists and technologists and the way they represent themselves. They should also note that exposing contradictions in the claims of opposing scientists or government or activists may not always help the public (broadly understood) sort out which claims are still the most reliable. Simply exposing a contradiction in a poorly framed public claim of an expert doesn’t necessarily discredit their whole areas of expertise.

(e) Challenge the excessive influence in science communication of partisan PR consultancies and encourage more direct engagement between scientists and publics. The dominance of corporate, university spin and science promotion PR means claims made by scientists in settings involved with controversial science and technology are often heavily mediated by PR concerns which often encourages very broad generalizations about science and technology to either boost or deconstruct claims. Science communicators should be critical of PR spin and encourage more direct engagement and responsibly mediated communication between scientists/experts and relevant publics. There have been numerous experiments with creating these new communication contexts bringing scientists and publics together which should continue to be supported.

(f) Enhance the awareness of science communicators of what specialist fields of knowledge such as Philosophy of Science, History of Science and Technology and Sociology of Science actually have to offer and encourage ideas from these fields to

be explained clearly. This would hopefully not discourage references to science in general and epistemology altogether, but encourage such references to be made more carefully and in communication contexts where the subtleties involved could be given a chance to be properly digested and not merely opportunistically added as fuel to pre-existing positions in debate.